Short Communication

Contraindication of live vaccines in immunocompromised patients: an estimate of the number of affected people in the USA and the UK

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A R T I C L E   I N F O

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Live attenuated vaccines (LAVs) offer strong cellular and antibody responses for protecting at-risk populations from severe infectious diseases. Examples include the measles, mumps, herpes zoster, varicella, and yellow fever vaccines. LAVs, however, are usually contraindicated for individuals with immunocompromising (IC) conditions because of a low risk, based on clinical evidence or theoretical considerations, that the partially attenuated vaccine strain could revert to the wild-type form and cause disease. At the same time, individuals with IC conditions need vaccines because they are at an increased risk of severe infections. In cases where alternatives to live vaccines are not available for individuals with IC conditions, the risk of potential adverse events from the vaccine must be weighed against the risk of disease from the wild-type pathogen.

To make informed decisions about developing or offering alternative vaccines to people with IC conditions, an estimate of the size of the IC population is needed. The only estimate to date, published in 2001, suggested that close to 10 million individuals in the USA or 3.6% of the population had IC conditions, although the authors explained that this was a ‘back of the envelope’ calculation based solely on the sum of the numbers of organ transplants, individuals with diagnosed and undiagnosed human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) and patients with cancer.

To better understand the unmet need for alternative vaccines in the adult IC population, we estimated the total burden of 11 main IC conditions listed as contraindicated conditions in international vaccination guidelines and recommendations. The GLOBOCAN database was used for cancer incidence and prevalence rates. For all other IC conditions, incidence and prevalence rates were obtained by a search of PubMed and, where data were unavailable, by a search for surveillance data available online (Table 1). When more than one source of data with the necessary age stratification (18 years) was available, we selected the one with the highest quality, most representative data using a tool adapted from the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies.

Although our initial goal was to make estimates for 10 countries, our search of peer-reviewed articles and surveillance databases yielded sufficient data only for the USA and UK. Based on the data we collected, we estimated that in 2012, 7.6 million adults (>18 years old) in the USA and 1.7 million adults in the UK had one of the IC conditions listed in Table 1.

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Table 1 – Incidence and prevalence of IC conditions in adults in the USA and UK.

<table>
<thead>
<tr>
<th>IC condition</th>
<th>Measure</th>
<th>USA</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. per 100,000 persons or person-years</td>
<td>Year</td>
<td>Estimated no. of cases</td>
</tr>
<tr>
<td>Solid organ malignancies</td>
<td>Prevalence</td>
<td>362.05&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2012</td>
</tr>
<tr>
<td>Haematological malignancies</td>
<td>Incidence</td>
<td>460.57&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2012</td>
</tr>
<tr>
<td>Psoriasis</td>
<td>Prevalence</td>
<td>35.14&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2012</td>
</tr>
<tr>
<td>Systemic lupus erythematosus</td>
<td>Incidence</td>
<td>50.41&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2012</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>Prevalence</td>
<td>883&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1990–2009</td>
</tr>
<tr>
<td>Ulcerative colitis</td>
<td>Incidence</td>
<td>74.3&lt;sup&gt;f&lt;/sup&gt;</td>
<td>1990–2009</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>Prevalence</td>
<td>143.75&lt;sup&gt;g&lt;/sup&gt;</td>
<td>2000–2004</td>
</tr>
<tr>
<td>HSCT</td>
<td>Incidence</td>
<td>72.7&lt;sup&gt;h&lt;/sup&gt;</td>
<td>2003–2008</td>
</tr>
<tr>
<td>Crohn’s disease</td>
<td>Prevalence</td>
<td>96.3&lt;sup&gt;i&lt;/sup&gt;</td>
<td>2002</td>
</tr>
<tr>
<td>Solid organ transplant</td>
<td>Incidence</td>
<td>6.3&lt;sup&gt;j&lt;/sup&gt;</td>
<td>1996–2002</td>
</tr>
<tr>
<td>End-stage renal disease</td>
<td>Incidence</td>
<td>16.7&lt;sup&gt;k&lt;/sup&gt;</td>
<td>2012</td>
</tr>
<tr>
<td>Total</td>
<td>Incidence</td>
<td>78.9&lt;sup&gt;l&lt;/sup&gt;</td>
<td>1990–2009</td>
</tr>
</tbody>
</table>

The GLOBOCAN database was used for cancer incidence and prevalence rates. For all other IC conditions, peer-reviewed articles in English published in the last 5 years were identified by a search of PubMed on October, 2013 using the following search string: [IC condition] AND (incidence OR prevalence) AND [country]. When more than one publication was found with the necessary age stratification (18–years), data from the highest quality study were selected using a tool adapted from the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies (http://www.ephpp.ca/tools.html). When data were not found in the initial search, the search was extended to the last 10 years if data were still not found, they were obtained from online global surveillance databases when available, or if not, from country-specific surveillance databases identified using the Google search engine. Abbreviations: HIV/AIDS, human immunodeficiency virus/acquired immune deficiency syndrome; HSCT, haematopoietic stem cell transplant; ND, no data; Ref, reference; No: number; IC: immunocompromising.


<sup>b</sup> Based on the 2012 adult population in the USA (240,185,952). Source: http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtm?src=bkmk.


<sup>e</sup> Cases presented are based on age-standardized rates, which were calculated based on 2012 population data using age-specific rates reported (where available) and the 2012 census data to estimate the cases for the ≥18 years old population.


This represents 3.17% of the total adult population in the USA and 3.47% of the total adult population in the UK. Each year, there are an estimated 1.8 million new cases of IC conditions in the USA and 0.36 million in the UK.

These estimates are subject to differences in case ascertainment, not to mention differences in data collection and reporting for each condition. For example, the incidence and prevalence rates for psoriasis were twice as high in the UK as in the USA. Possible explanations are differences in case ascertainment, demographics, geography, methodology, case definitions and definitions of prevalence. In addition, we used only a single data source for incidence or prevalence in each country, using alternative sources, especially for the more dominant IC conditions like HIV/AIDS and malignancies, could have some effect on the estimates. Regardless, the numbers for the IC population in the USA are in line with the previous estimates, and the overall prevalence of IC conditions is similar for the USA and UK, suggesting that our estimates are reasonable.

Not all subjects with chronic conditions like systemic lupus erythematosus, psoriasis, rheumatoid arthritis and inflammatory bowel disease will be on immune-suppressive treatments at any point in time, but little data is available to determine the corresponding proportions. Similarly, for HIV/AIDS, not all subjects will be immunosuppressed at any given time (i.e. CD4 counts <200) and, again, the proportion is difficult to determine from available data. To help address this limitation, we tested a scenario in which half of patients with these conditions are considered immunosuppressed at any given time. Based on this assumption, and using the unaltered estimates for the remaining conditions, the estimated number of adults with IC conditions was 4.6 million in the USA (1.92%) and 1.0 million in the UK (1.0%).

These estimates are only a first step in understanding how many individuals with IC conditions require alternative vaccines. Many other variables must be considered, notably, the cause and severity of immunosuppression for each IC condition, which can vary greatly, and for individuals receiving immunosuppressive treatments, the level and duration of immunosuppression for which LAVs should be contraindicated. In addition, the nature of each infectious disease, the risk of exposure to it and its associated morbidity must be considered when determining who should or should not receive LAVs.

In summary, despite the limitations to our analysis and lack of data for countries other than the USA and the UK, our calculations suggest that roughly 2–3% of the global adult population lives with an IC condition and might benefit from alternative vaccines to LAVs. This estimate is meant as a starting point for understanding the magnitude of the need for alternatives to LAVs. Although the numbers and percentages appear to be reasonable for the UK and the USA, and therefore perhaps also for upper-income countries in general, they may not be accurate for individual countries, especially lower-income countries. Analyses of large datasets, coupled with harmonized case ascertainment and data collection, as well as additional country-specific data on disease burden are needed to make more accurate estimates.
GC, LV, EB, HV and FvK performed the analysis. AO, AG, DC, GC, EB, HV and FvK participated to the interpretation of the results. DC and LV provided statistical expertise.

REFERENCES